obtained, to show that the method would work? This is a particular problem with claims 6 and 7, which require hole creation by irradiation. Has this result been accomplished, or merely predicted?

Applicants respectfully submit in response that the experimental device shown in Figure 1 of the present application, as stated in the specification, is itself a transistor having the regions defined in the claims. Particularly, as stated beginning on page 7, line 3, the "experimental device of Fig. 1 models the action of a FET transistor using a scanning tunneling microscope 10". Continuing at line 8, "in this two-terminal arrangement, the tip 12 acts as the source, while the substrate 16 acts as the drain". Accordingly, Applicants submit that the "transistor action" stated to be missing in the office action is modeled by the experimental device shown in Figure 1 and the experimental results provided in the application. The scanning tunneling microscope modeling the FET clearly demonstrates the essential effects needed to enable single particle tunneling transistor action.

The office action states, "[O]ne of ordinary skill would not understand 'source' or 'drain' to refer to electrodes such as those of Figure 1". However, Applicants believe that one of ordinary skill would understand the source and drain clearly to refer to tip 12 and substrate 16, respectively, because the relationship is specifically provided in the application.

Thus, the source and drain of the model FET transistor is clearly enabled by the present application. In other words, no "undue experimentation" would be required to generalize the results of Figure 1 to produce a transistor, because Figure 1 itself models a transistor. The experimentation has been performed by Applicants themselves.

As to the office action's concerns regarding experimental results, Applicants respectfully submit that Figs. 2 and 3, taken together, show results "consistent with the characteristic single electronic charging . . . thus, the single electron device is operational based on the charging effect" (page 8, lines 12-14). As to hole creation by irradiation particularly, the experimental results showing that this method would work are clearly provided by Figs. 4 and 5 and the accompanying description, which states that film 14 containing nanoparticles 18 are stimulated by the light by from a mercury lamp. As clearly provided by, for example, page 9, lines 10-15, "the light effect can simply be understood in terms of hole generation . . . light irradiation . . . creates the necessary holes for the process to proceed." This conclusion is believed to be supported at least by the I-V curve of Figure 4 and derivative curve of Figure 5.

In response to the office action's statement that transistors are three-terminal devices where one of the terminals (the gate) controls current flow between two other terminals, Applicants respectfully submit that the nanoparticle film material 14 and silicon nanoparticles 18 contained in the film are implanted as a buried gate layer, thus providing, with the tip 12 and substrate 16, the terminals referred to in the office action.

As a model transistor has been clearly shown and described, with experimental results produced and provided, Applicants respectfully submit that all features of claims 5-7, including the feature of creating holes by irradiating silicon nanoparticles as set out in claims 6 and 7, are clearly described and enabled by the present application. Therefore, Applicants respectfully request reconsideration and withdrawal of the rejection.

Claims 1, 4, 5, and 8 stand rejected under 35 U.S.C. §103(a) as being unpatentable over Chen in view of Forbes and Pankove. Claims 6 and 7 stand rejected under 35 U.S.C. §103(a) as being unpatentable over the references stated above, and further in view of Matsumura. Applicants respectfully traverse the rejection.

As a preliminary matter, the office action appears to be relying solely on the Forbes reference at this point for supporting its conclusion that the claimed feature of a buried gate layer of silicon nanoparticles wherein the silicon nanoparticles have a diameter of approximately 1 nm is obvious when combined with Chen or anticipated by Forbes itself. Neither the present office action nor the May 6, 2003 office action responds to Applicants' arguments regarding the other references and their inability to teach, suggest, or enable the claimed silicon nanoparticles. Applicants' present arguments therefore are directed to Forbes as well.

The office action states, "The reference teaches a process which produces uniform sized particles. A uniform size of 10 [angstroms], for example, is obtained by 'a particular set of processing conditions' (column 4, line 60-67). A uniform size of 100 [angstroms] is obtained by another set of processing conditions." Applicants respectfully traverse this statement, as it appears to misinterpret Forbes.

Forbes discloses an annealing method for producing silicon nanoparticles. As stated in column 4, lines 13-20:

> The silicon crystals can be made in a variety of sizes with a <u>uniform distribution in particle sizes</u> by appropriate anneal conditions. Although the particles may not be formed in a uniform sphere, they can be described as

having a general diameter of approximately 10 [angstroms] to 100 [angstroms] (emphasis added).

Furthermore, as stated in column 4, lines 63-66, "These particles have a diameter in the size range of approximately 10 [angstroms] to 100 [angstroms] and are in a uniform size distribution for a particular set of processing conditions (emphasis added)".

Applicants submit that Forbes does **not** teach or enable a process that produces uniform sized particles. In fact, the opposite is true. The phrases "uniform distribution in particle sizes" and "uniform size distribution" refer to a statistical uniform distribution, which means that the probability of any particle in the group of particles being a particular size within a range is the same as the probability of the particle being any of the other sizes within the range. In other words, Forbes merely states that within an approximate range of 10 angstroms to 100 angstroms, particles of various sizes will be produced, in about the same proportion for each size. This is the complete opposite teaching from "a process which produces uniform sized particles". Applicants have provided herein documents with an explanation of uniform distributions, to further understanding of the term "uniform distribution in particle sizes".

Applicants believe that a possible reason for the quite general range and particle size description presented by Forbes is that it likely is unknown what the size of any particular particle is. Instead, it appears that a uniform distribution of sizes is present within any of various ranges, depending on "a particular set of processing conditions", which apparently refers to particular annealing conditions. Applicants thus respectfully traverse the office action's statement that Forbes teaches a uniform size of 10 angstroms.

Further, Applicants respectfully submit that Forbes does not enable or teach 1 nm diameter silicon nanoparticles, as it instead discloses only the ability to produce a general range of variously sized particles, for at least the reasons stated above. The "set of processing conditions" provided in Forbes, at best, produces a broad range of particles with an approximate low end and an approximate high end. As 10 angstroms, even as an approximate value, is stated to be the absolute low end of a uniform distribution, Applicants respectfully submit that any existence of such particles appears much more likely to be an outlier within an expected range, than an intentional (and enabled) result. Thus, Forbes does not appear to anticipate the pending claims, nor does it appear to remedy the deficiencies of Chen regarding the claimed 1 nm silicon nanoparticles.

Additionally, Applicants respectfully submit that simply implanting the range of uniformly distributed sizes of silicon nanoparticles, as provided in Forbes, into a device such as that disclosed in Chen, appears to likely make the single electron transistor device defined in the present claims inoperable. This is at least because the voltage threshold (on/off switching) of such a device depends on the charging energy and/or the quantum electronic energy of the particle; i.e., the diameter of the particle. For substantially uniform particles, the threshold is sharply defined. However, with a range of sizes, such as taught in Forbes, simultaneously in action, the sharp threshold of the device is washed out, thus appearing to render it inoperable. Particularly, the charging energy is inversely proportional to the particle diameter. Thus, for a range of 10 angstroms to 100 angstroms as taught in Forbes, the charging energy changes by an order of magnitude. The situation for the electronic energy is even worse, as it is inversely proportional to the square of the diameter, and thus two orders of magnitude variation are present over the uniform size distribution taught in Forbes.

In sum, Forbes does not appear to teach, suggest, or enable the buried gate layer of silicon nanoparticles as defined in the claims, nor, apparently, can it be combined with Chen to teach or suggest this feature. Because this appears to be the sole support for the office action's rejection (as Applicants' previously submitted arguments regarding the other references have not been addressed), Applicants respectfully request reconsideration and withdrawal of the rejection.

For at least the foregoing reasons, Applicants believe that this case is in condition for allowance, which is respectfully requested. The Examiner should call Applicants' attorney if an interview would expedite prosecution.

Respectfully submitted,
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